ASSIGNMENT- 1

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Download all python codes from

https://github.com/Mastan1301/EE3025/tree/main/Assignment−1/codes

and latex-tikz codes from

https://github.com/Mastan1301/EE3025/tree/main/Assignment−1

1 Problem

The command

```
output_signal = signal.lfilter(b,a,
    output_signal)
```

in Problem 2.3 is executed through following difference equation

$$\sum_{m=0}^{M} a(m)\, y(n-m) = \sum_{k=0}^{N} b(k)\, x(n-k) \tag{1.0.1}$$

where input signal is $x(n)$ and output signal is $y(n)$ with intial values all 0. Replace **signal.filtfilt** with your own routine and verify

2 Solution

Using the properties of z-transform

$$\mathcal{Z}\{x(n-k)\} = z^{-k}X(z) \tag{2.0.1}$$

$$\mathcal{Z}\{y(n-m)\} = z^{-m}Y(z) \tag{2.0.2}$$

where $X(z)$ and $Y(z)$ are the respective z-transforms of $x(n)$ and $y(n)$ respectively.
Applying z-transform on both sides in (1.0.1),

$$Y(z)\sum_{m=0}^{M} a(m)\, z^{-m} = X(z)\sum_{k=0}^{N} b(k)\, z^{-k} \tag{2.0.3}$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{\sum_{k=0}^{N} b(k)\, z^{-k}}{\sum_{m=0}^{M} a(m)\, z^{-m}} \tag{2.0.4}$$

From the coefficients b,a and from (2.0.4), we obtain $H(K)$.
The np.fft function is used to compute DFT $X(K)$ from $x(n)$.
To obtain $y(n)$, we first compute $Y(K)$ from,

$$Y(K) = H(K)\, X(K) \tag{2.0.5}$$

Then, we use ifft function to compute $y(n)$ from $Y(K)$ and store the result in a wav file.
The python code for the problem is -

codes/ee18btech11039.py

Below is the soundfile constructed using own routine-

codes/Sound_With_ReducedNoise_1.wav

The soundfile obtained using library function -

codes/Sound_With_ReducedNoise_2.wav

3 Verification

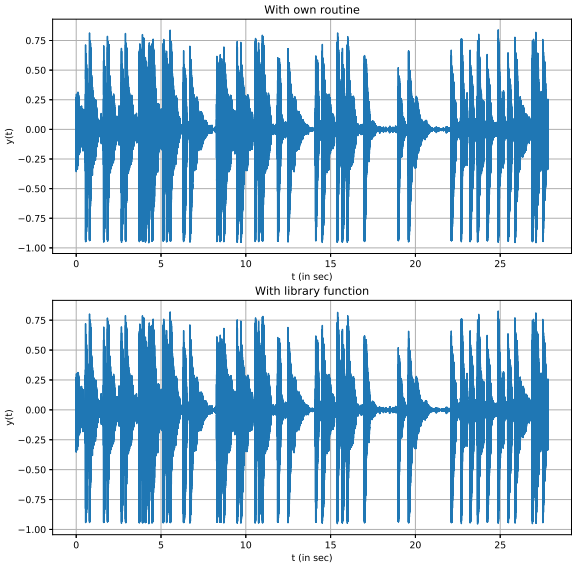

Fig. 0: Time domain response

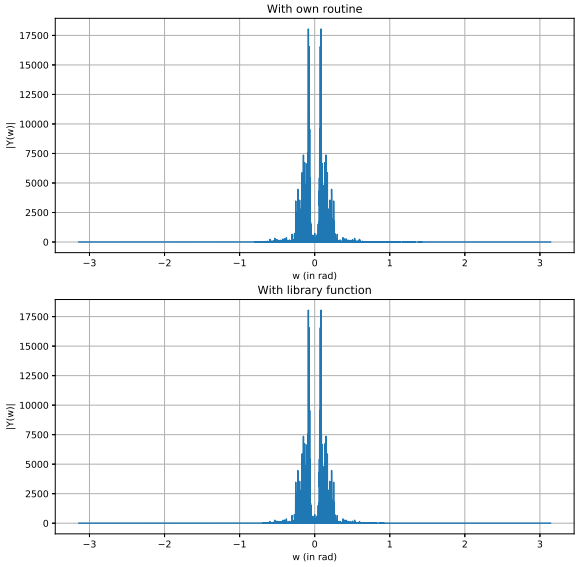

Fig. 0: Frequency domain response